

he died of consumption at the early age of 33, in the midst of a promising career.

He was the author of several books, the last of which—*Harris's Mining Laws*, published in 1877—is a work of much use to the profession.

He was elected a Fellow of this Society on February 11, 1870, and was a member of the Eclipse Expedition to Sicily in that year.

WILLIAM LASSELL died at Maidenhead, October 5, 1880, aged 81 years. He was born at Bolton, Lancashire, June 18, 1799. He acquired the rudiments of education at a day school in his native town, during which period his father died, and he thence went for eighteen months to an academy at Rochdale.

In 1814 he entered a merchant's office at Liverpool, and there served a seven years' apprenticeship. He commenced business in Liverpool as a brewer about the year 1825, without, however, much taste or inclination for trade, and spent almost all his leisure time in his favourite pursuit of astronomy and the mechanics connected therewith.

Mr. Lassell possessed a great love and aptitude for mechanical invention, and for this reason "he belonged," to use the words of Sir John Herschel, "to that class of observers who have created their own instrumental means, who have felt their own wants, and supplied them in their own way." The qualities which enabled Mr. Lassell to do all this made him what he was. The work was the revelation of the man. He felt precisely where lay the difficulties and wants which met him in his work, because he was sensitive and sympathetic. He could deal successfully with these difficulties and supply these wants often in a masterly and original way, because he could think for himself cautiously yet boldly. He could work out his conceptions in new and difficult directions to a successful issue, because the constancy of his character showed itself here in concentration of thought and perseverance of action. These qualities, sensitive sympathy, wise prudence, constancy, were those which pre-eminently characterised him as a man and made him to those who knew him a friend of rare worth.

In the history of science Mr. Lassell's name will rank with those of Herschel and the late Lord Rosse in connection with that essentially British instrument, the reflecting telescope, whether we consider the genius and perseverance displayed in the construction of these instruments, or the important discoveries which have resulted from their use. About 1820 Mr. Lassell, then in his twenty-first year, began to construct reflecting telescopes for himself. It is perhaps to circumstances which he at the time considered unfavourable that science is indebted for much that Mr. Lassell has accomplished. At that time he did not possess sufficient means to enable him to purchase expensive instruments, and besides "his business avocations were such as

most men consider of an engrossing nature." The value to him in his subsequent work of the energy and power of resource which were in this way so strongly developed in his character at an early age, it is difficult rightly to appraise. His success with the first two instruments, which he attempted simultaneously (a Newtonian of seven inches' diameter and a Gregorian of the same size), encouraged him to make a Newtonian of nine inches' aperture. The instrument, which was erected in an Observatory at his residence near Liverpool, happily named Starfield, may be said to form an epoch in the history of the reflecting telescope, in consequence of the successful way in which Mr. Lassell, on a plan of his own, secured to it the inestimable advantages of the equatoreal movement. The several mirrors made for this instrument were of great excellence. The Observatory note-books of the late Mr. Dawes, which are in the writer's possession, bear record to the delicate tests for figure to which these mirrors were put on the occasion of the frequent visits of Mr. Dawes to his friend's Observatory. With this instrument Mr. Lassell worked diligently, and detected, without knowledge of its existence, the sixth star in the trapezium of the Nebula of *Orion*. This instrument is fully described in the twelfth volume of the *Memoirs of the Royal Astronomical Society*.

About the year 1844 Mr. Lassell conceived the bold idea of constructing a reflector of two feet aperture and twenty feet focal length, to be mounted equatoreally on the same principle. He spared neither pains nor cost to make this instrument as perfect as possible, both optically and mechanically. As a preliminary step he visited the late Earl of Rosse at Birr Castle, and commenced the specula for the new instrument upon a machine similar in construction to that employed by that nobleman. After some months' work he was not satisfied with this apparatus, and was led in consequence to contrive a machine for imitating as closely as possible those motions of the hand by which he had been accustomed to produce perfect surfaces on smaller specula. "The essential difference of these constructions," to use the words of Sir George Airy, "as regards the movements of the grinder, is this: that in Lord Rosse's apparatus every stroke is very nearly straight, while in Mr. Lassell's apparatus there is no resemblance to a straight movement at any part of the stroke." This is not the place to describe the many new contrivances in the mode of support of the mirror, in the equatoreal mounting, in the polishing machine, and in the arrangements of the dome under which it was erected, which enabled Mr. Lassell to bring his telescope to a high degree of perfection. In this connection it should be noticed, to use Sir John Herschel's words, "that in Mr. Nasmyth he was fortunate to find a mechanist capable of executing in the highest perfection all his conceptions, and prepared by his own love of astronomy and practical acquaintance with astronomical observations, and with the construction of specula, to give them their full effect."

With this fine instrument he discovered the satellite of *Neptune*. This minute body was seen on October 10, 1846, but it was not until the next year that it could be satisfactorily followed and its existence fully confirmed. The superiority of the telescope and the vigilance and skill of the observer were further shown by the discovery in 1848, simultaneously with Professor Bond in America, of an eighth satellite of *Saturn*, of extreme minuteness, which was named *Hyperion*. In 1851, after long and careful search, he established the existence of two additional satellites of the planet *Uranus* (*Umbriel* and *Ariel*), interior to the two discovered by Sir William Herschel in 1787.

In the autumn of 1852 he took this twenty-foot telescope to Malta, and observed with it there through the winter. A very careful and detailed drawing of the Nebula of *Orion*, and drawings of several planetary nebulae made at Malta, will be found in vol. xxxiii. of the *Memoirs* of the Royal Astronomical Society. With respect to the planets, his discoveries, to use his own words, "were rather negative than otherwise," for he was satisfied, that without great increase of optical power, no other satellite of *Neptune* could be detected. With regard to *Uranus* he says: "I am fully persuaded that either he has no other satellite than the four, or, if he has, they remain yet to be discovered."

Mr. Lassell's energy and zeal in the cause of science did not permit him to remain content with this magnificent telescope. His last work was a much larger telescope—four feet in aperture and thirty-seven feet focus, mounted equatorially, which was erected at Malta in 1861. The work done with it in the next three years, during the last two of which he was assisted by Mr. Marth, is described, as well as the instrument itself, in vol. xxxvi. of the *Memoirs* of the Royal Astronomical Society. This work consists of numerous observations of nebulae and satellites, and a catalogue of the places of 600 new nebulae discovered at Malta. It is not possible to suppress a feeling of regret that this grand instrument no longer exists.

Mr. Lassell was very successful in the great brilliancy and permanence of polish in his mirrors. Within the last few years the writer has been shown specula by Mr. Lassell, which had been polished for more than twenty years, and which appeared as bright as if but just removed from the polishing machine. His earlier metal differed from that employed by Lord Rosse, in that it contained a small quantity of arsenic in addition to copper and tin. In the case of his four-foot mirrors the arsenic was omitted. He seems to have considered that the perfection of the metal depended upon the accurate relative proportion of the copper to the tin, and that in consequence of the uncertainty of the state of purity of the metals, this proportion would be obtained with the necessary accuracy only by a series of testings, while the metal was in the pot.

After his return from Malta, Mr. Lassell purchased a residence near Maidenhead, and erected there in an Observatory his

equatoreal telescope of two-foot aperture. Mr. Lassell's experience in re-polishing his four-foot mirror suggested to him some alterations in his polishing machine. After his return he was able to carry out experiments in connection with the suggested alterations in a workshop erected at Maidenhead, and succeeded in constructing an improved form of polishing machine, which is described in the *Philosophical Transactions* for 1874. The numerous papers by Mr. Lassell, to be found in the *Monthly Notices* and the *Memoirs* of the Royal Astronomical Society, bear abundant record to his industry and skill, and make us feel that in Mr. Lassell's death we have to deplore the loss of one who contributed largely to the advancement of the science of his age.

He was elected a Fellow of this Society on June 14, 1839, and received the Gold Medal in 1849 "for the construction of his Equatoreal Instrument and for the discoveries made with it;" the address, in presenting the medal, being delivered by the President, Sir J. F. W. Herschel. He was elected President of the Society in 1870, and, as usual, held the office for two years. He was for many years a member of the Council, and was a most regular attendant at its meetings up to his death.

He was elected a Fellow of the Royal Society in 1849, and received one of the Royal Medals in 1858. Among other honours bestowed upon him, may be mentioned the honorary degree of LL.D. conferred upon him by the University of Cambridge, and the honorary membership of the Royal Societies of Edinburgh and Upsala.

W. H.

REV. ROBERT COMYN LUMSDEN was born at Dalkeith, and studied at the University of Edinburgh. He was elected a Fellow of the Royal Geographical Society in 1860, and of this Society on May 10, 1861. He died of apoplexy, after a few hours' illness, on October 25, 1880, aged 56.

BENJAMIN PEIRCE was born at Salem, Massachusetts, on April 4, 1809. He was the son of Benjamin Peirce, the librarian of Harvard, who died in 1831, and is well known in connection with his posthumous History of that University. He graduated at Harvard in 1829, and was made Tutor in 1831 and Professor in 1833. In 1842 he was appointed Perkins Professor of Astronomy and Mathematics in the University, and occupied this Chair until his death. He also held the offices of Consulting Astronomer of the American Ephemeris and Nautical Almanac from 1853 to 1867, and Superintendent of the United States Coast Survey from 1867 to 1874. From 1874 to his death he was Consulting Geometer of the Coast Survey. He died at his house at Cambridge, Mass., on October 6, 1880, after an illness of about three months.

The proof sheets of Bowditch's translation of Laplace's *Mécanique Céleste* were read by Peirce. On p. 61 of the *Mémoir*